

DECUS NO.

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TITLE

Paper Tape Duplicator (P.D.T.)

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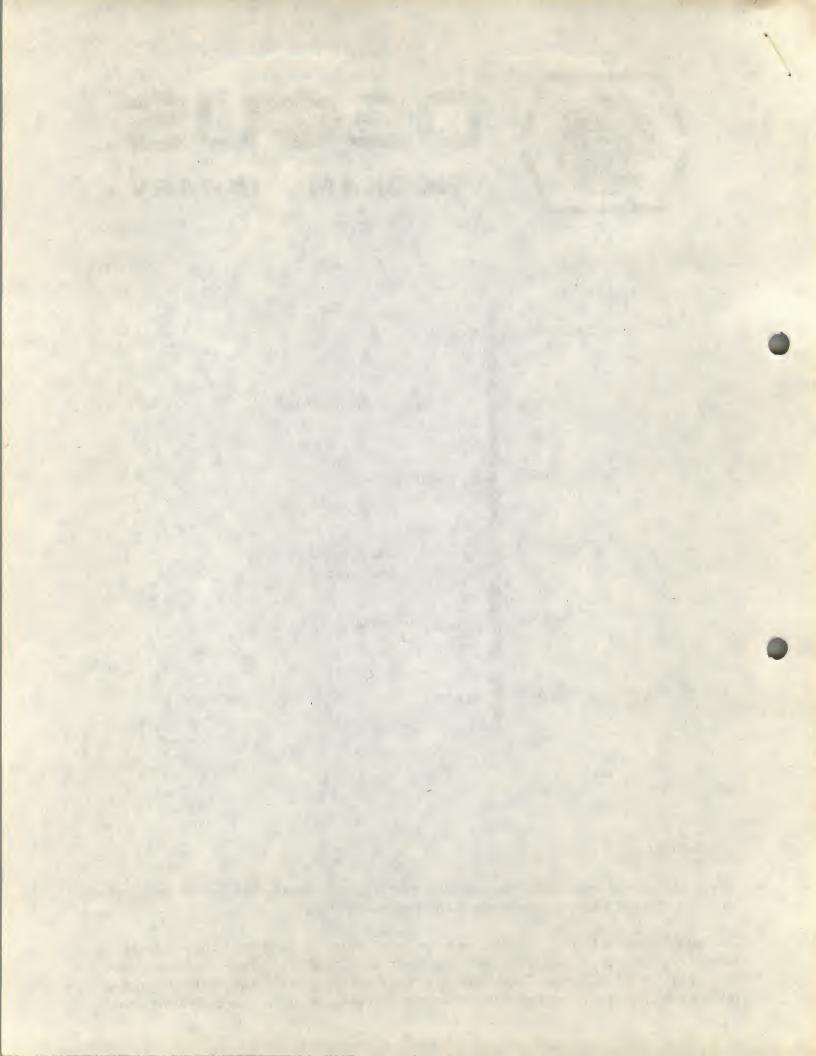
SOURCELANGUAGE

PAL III

# ATTENTION

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# PAPER TAPE DUPLICATOR (P.D.T.)

# Revision of 2/74

Purpose: To perform many of the functions of the DEC Master Tape Duplitor without using the interrupt facility.

Hardware: PDP-8 series processor, high-speed paper tape reader & punch. The program can be modified for low-speed punch and even for the low-speed reader.

Core: 10,11,20-161,176-431 plus storage buffer 600-7577, in any core field. Since interrupt is not used, this should run under TSS-8.

Input Format: Virtually any kind of paper tape can be copied. The tape should end in a square (not forked) tail if the high-speed reader is in use. Two or more successive rubouts are considered to mark the end of the tape.

## Output Format:

- (a) leader code, 63 frames of code 200 or of blanks (see below)
- (b) the original program with its trailer, copied "as is"
- (c) three Rubouts (original master tape) or two (copies)
- (d) Ctrl/Z (end of file), Ctrl/FORM (end of page)
- (e) a 24-bit straight checksum of all frames except the leader
- (f) a 24-bit circular checksum with end-around carry, to catch a punch that both drops and adds bits in the same channel
- (g) a short section of trailer.
- Ignored: (a) Leader, blank or code 200, until something else has been read.
  - (b) Rubouts immediately following 2 successive rubouts.

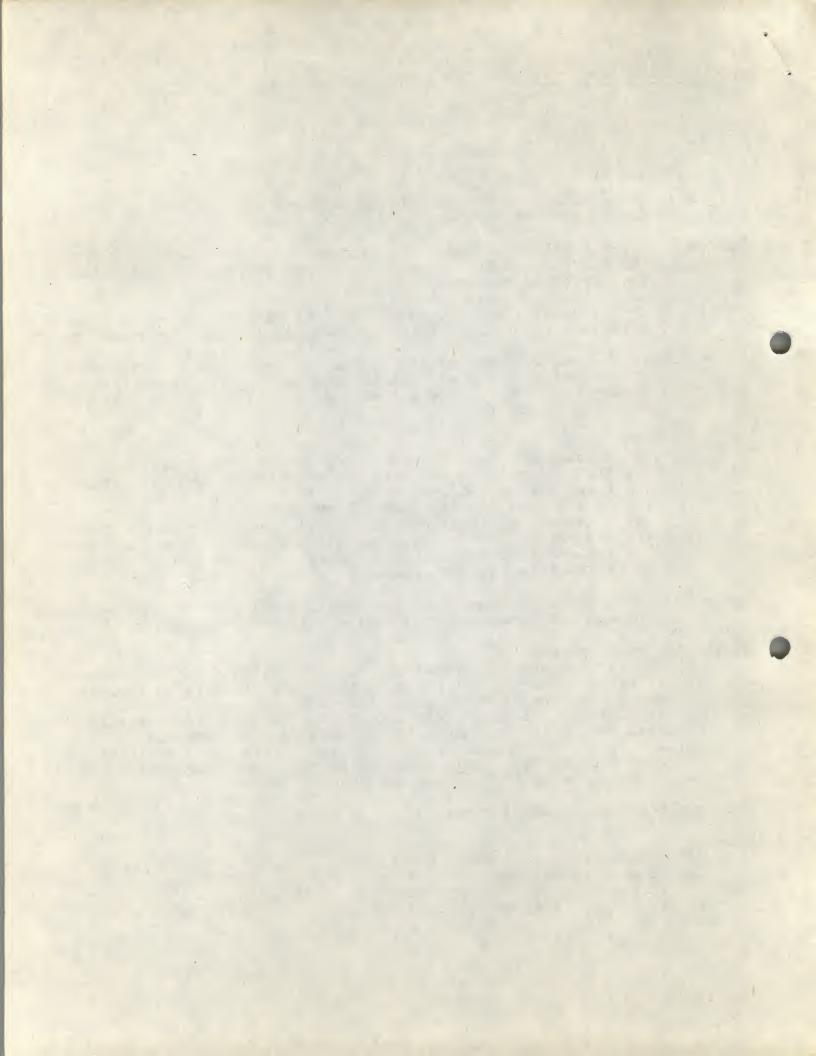
# Switch Register Options:

- (a) If bit 0 is set, a new master tape is created.
- (b) If bit 0 is clear, bit 1 set, a master or its copy is copied; the input tape is verified against its checksum.
- (c) If bits 0 & l are both clear, a master or its copy is simply read and verified against its checksum (no duplication).
- (d) Bit 4, if set, specifies code 200 leader/trailer; if clear, code 000 (blanks). RIM & BIN tapes must have code 200; ASCII (source) tapes may have either type of leader.

Teletype Messages to User: none.

#### Halts:

- (a) At address 176: normal, no errors.
- (b) At address 44: reader timed out. This has never happened here; it was included as a precaution against jams.
- (c) At address 426: bad checksum on input tape. See listing.



#### Notes:

(a) The checksum material is punched with parity set (channel 8 always punched). If the tape is a RIM tape, the RIM loader will ignore this, as it does any code 200 or higher.

(b) The combination of Ctrl/Z and FORM should stop input to almost

any editor or OS-8 program.

(c) Copies of binary tapes will presumably halt on the copy of the original code 200 trailer.

(d) Source tapes for assemblers will have a \$ or END, which will cause

the assembler to ignore all that follows.

In brief, the checksum material should prove relatively innocuous. To date, no tape that verifies has proved bad.

## Changing Devices:

(a) Switching to the low-speed punch is relatively easy. Change the 602x codes in 65,75,200,322,324 to the corresponding 604x codes.

(b) The reader is another matter, because of the 25-millisecond timing loop. Your options are to change the timing loop--probably an off-page jump to, say, loc. 432 will be needed--or to take it out and count on typing 2 rubouts by hand when end of input tape is reached.

## Use:

(a) Load with binary loader into any core field.

(b) Load starting address = 0200 in that field.

(c) Choose your switch register options -- see previous page.

(d) Check your reader and punch. Both should be on, the input tape in the reader ready to go.

(e) Press Clear and Continue ['Start' on earlier PDP-8's].

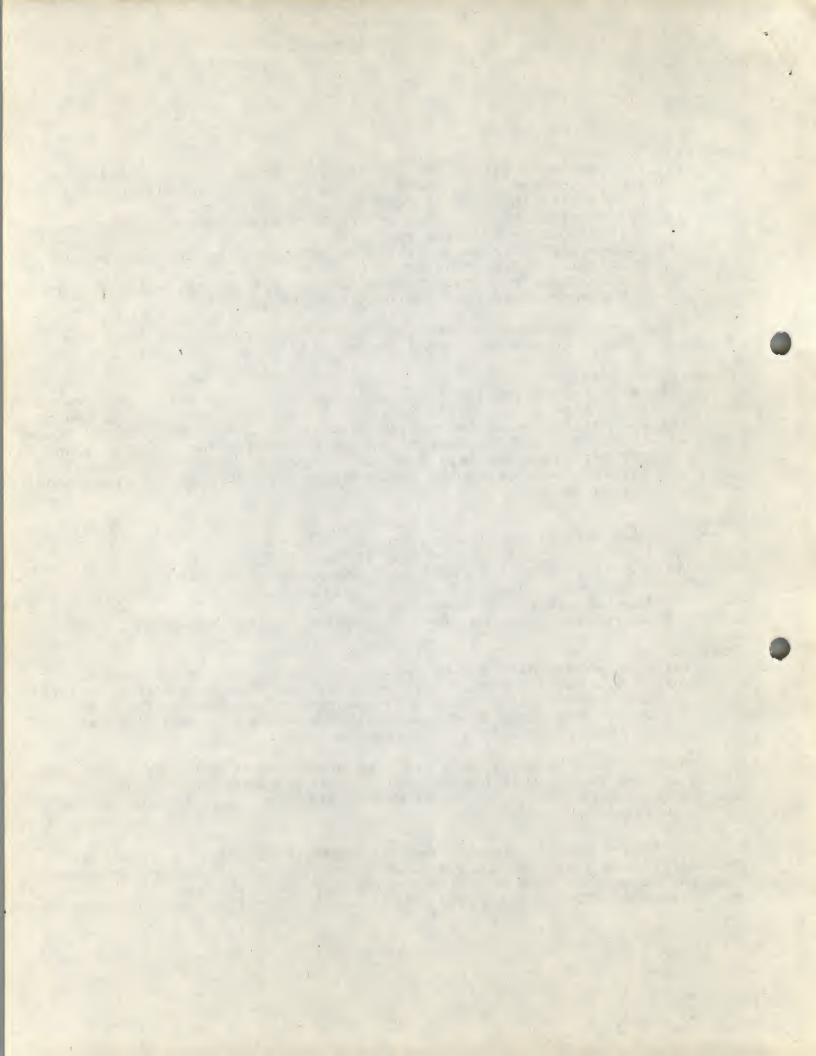
### Restart:

(a) From normal halt and checksum error halt, just press Continue.

(b) If a time-out halt is due to end of tape, press Continue to finish job. The HLT in location 44 was put in because, in fact, the writer has never seen a tape time out--the tail end gets read by the H.S.R. as a lot of rubouts.

This version is compatible with its predecessors. The principal changes: (a) larger text buffer (b) the bit 4 option (c) removal of instructions peculiar to the PDP-8/E and later models (d) reformatting of the listing.

For those whose high-speed readers consistently halt (loc. 44) on time-out rather than on multiple rubouts, perhaps the following is better than the suggestion made on the first page of the listing: Into loc. 44, deposit 7040; into loc. 45, deposit 1135 [simulates rubout.



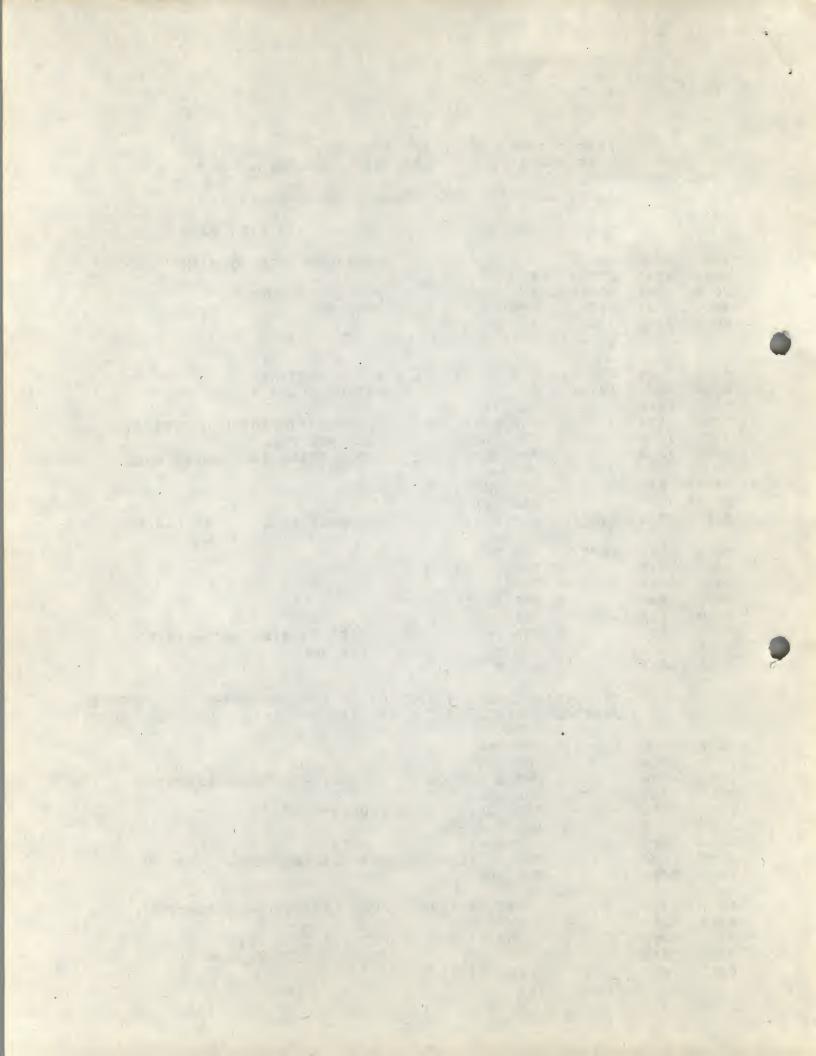
# /PAPER TAPE DUPLICATOR (P.D.T.): /FOR PDP-8 SERIES COMPUTERS, H. S. R./H. S. P.

/REV. 2/23/74 PAS PAGE Ø ROUTINES &C.:

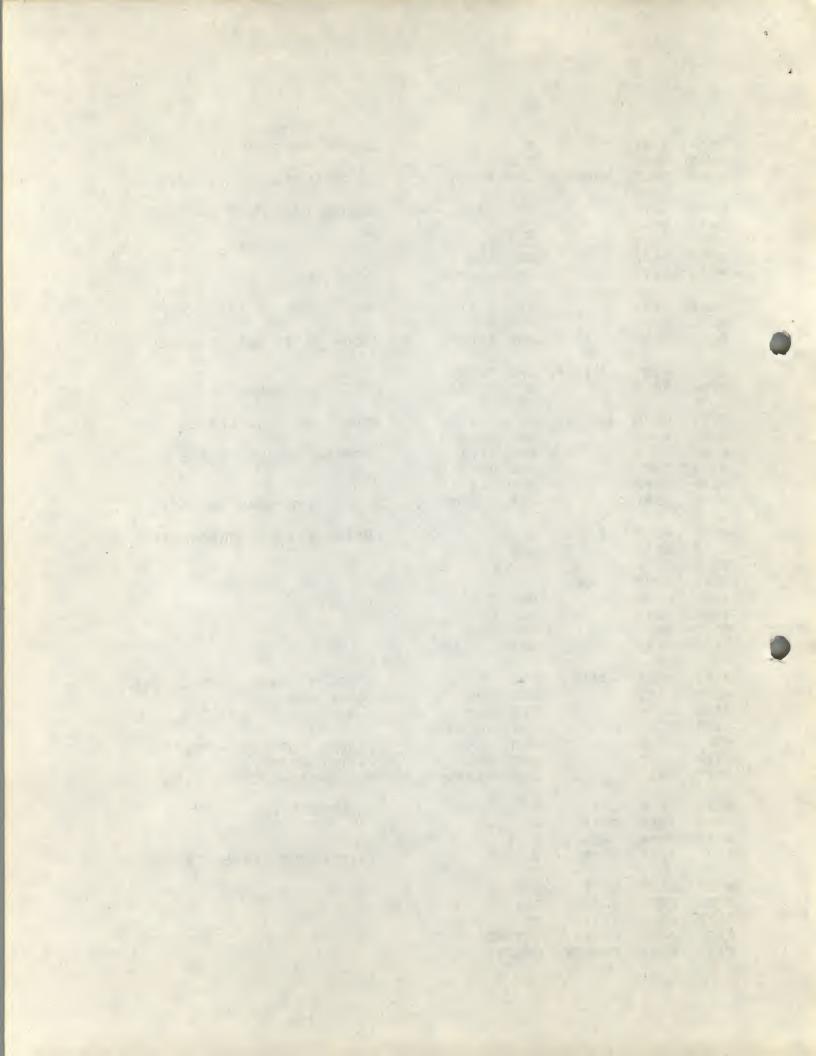
		*20		/0-7, 12-17 LEFT FREE
0020	0000	EXIT,	Ø	POINTER BACK TO MAIN PROGRAM
0021	0000	CTR2,	Ø .	*
0022	0000	RBTFLG.		/-1 AFTER RUBOUT
0023	0577	BOTM,	577	/BUFFER: 600 TO 7577
0024	0000	SAVE,	Ø	
		DMY=	ZNOR	
0025	7200	READP,	CLA /READ &	PUNCH ROUTINE:
0026	0000	SW1,	0	/WILL HOLD Ø OR JMP PUN
 0027	1010		TAD 10	
0030	1133		TAD K201	/CUPPER STORAGE LIMIT=7577]
0031	7640		SZA CLA	/STORAGE FULL
0032	5036		JMP TIME	/ROOM STILL IN STORAGE AREA
0033	1035	**	TAD KJMPI	
0034	3026		DCA SW1	
0035	5064	KJMPI,	JMP PUN	/STORAGE FULL. SKIP READER
0036	3101	TIME,	DCA DMY	
0037	6011		RSF	
0040	7410		SKP	
0041	5046		JMP READIT	
0042	2101		ISZ DMY	
0043	5037		JMP4	/ABOUT 25 MILLISECS. (8/E)
0044	7402		HLT	/ COR NOPI
0045	5420		JMP I EXIT	

/AUTHOR'S READER TRIPS OUT ON RUBOUTS AFTER END OF TAPE, /NOT ON TIMING. IF YOURS ACTS OTHERWISE, NOP THE 'HLT'.

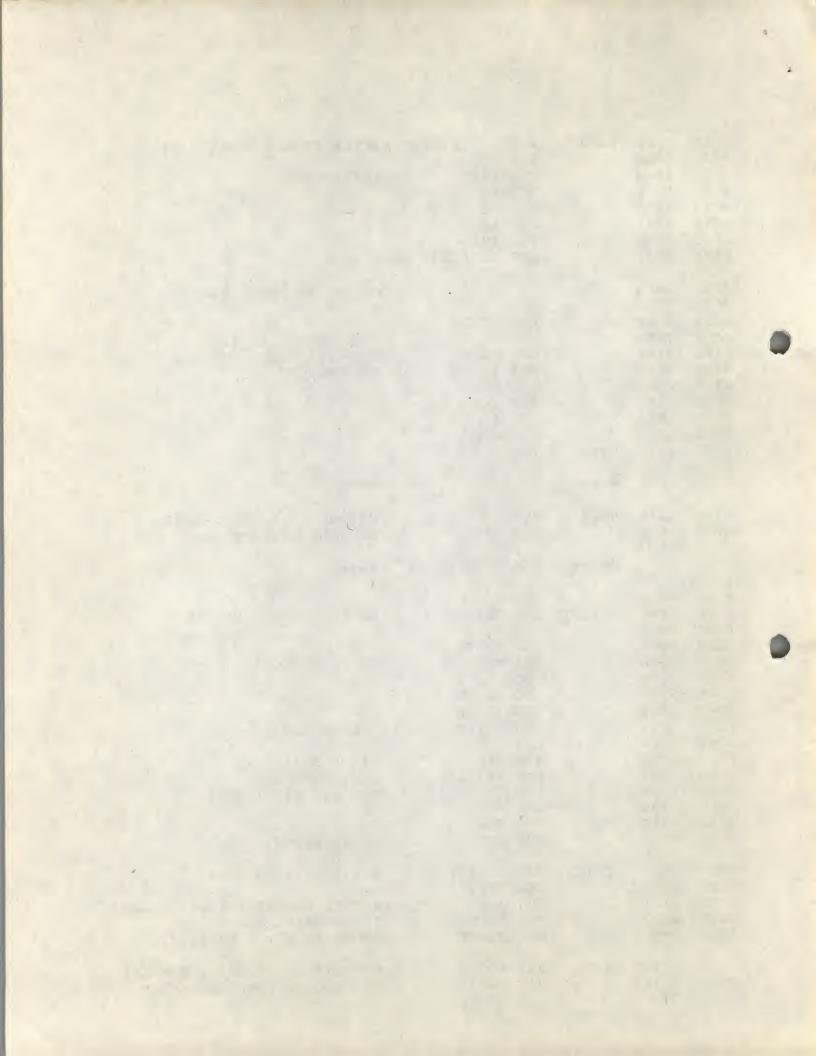
0046	6016	READIT, RRB RFC	**
0047	3024	DCA SAVE	• (
0050	4536	JMS I PCHECK /STORE, ADD TO	CHECKSUMS
0051	1024	TAD SAVE	
0052	1176	TAD HALT /RUBOUT?	
0053	7740	SMA CLA SZA	
0054	5057	JMP .+3 /YES	
0055	3022	DCA RBTFLG /NO. CLEAR FL.	AG.
0056	5064	JMP PUN	
		/	
0057	2022	ISZ RBTFLG /WAS LAST CHAR	A RUBOUT?
0060	7410	SKP	
0061	5420	JMP I EXIT /YES, 2 IN A RO	W
0062	7040	CMA /NO, BUT SET FI	
0063	3022	DCA RBTFLG	
		1	



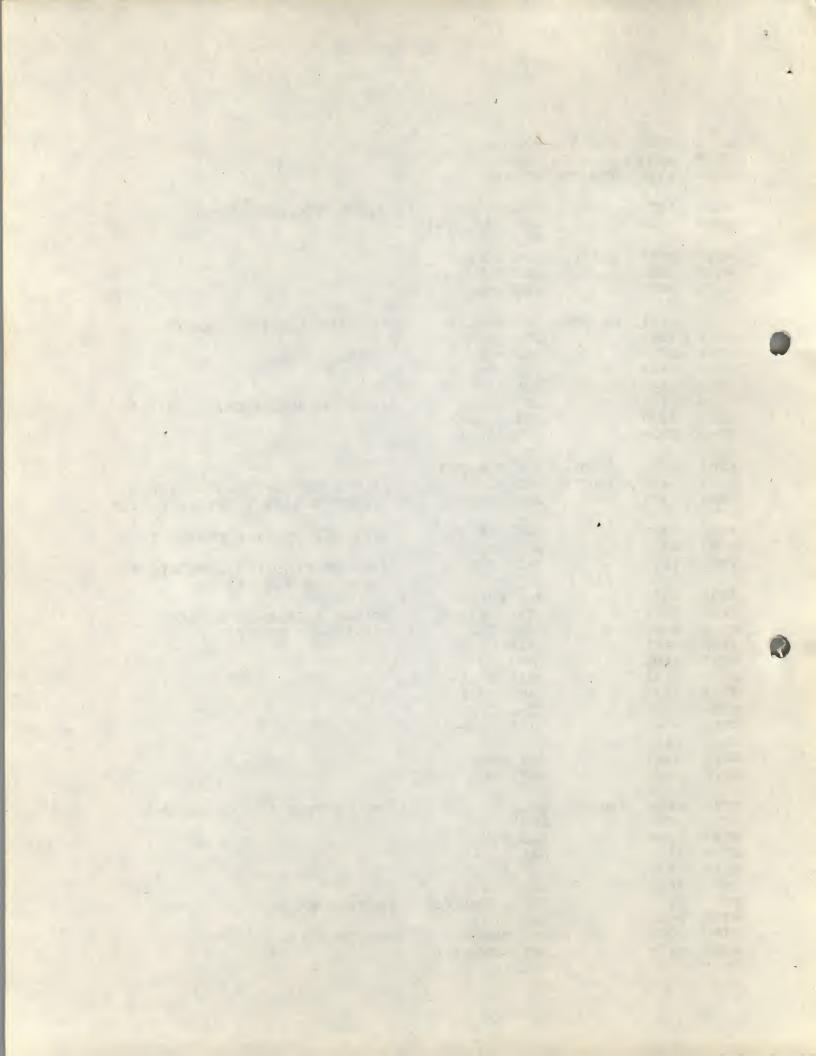
	0000	PUN,	Ø	A -	/0 OR JMP READP
0065	6021		PSF		
0066	5025	KJMP2,		READP	/LOOP UNTIL END OF TAPE
	0200		0	HENDI	THE THE WATTE END OF TAPE
	1010	\		10	/PUNCH CAUGHT UP W. READER?
0070	7041		CIA		4
0071	1011		TAD	11	Walter Company of the
	7650			CLA	
0073					44
0013	3011		JMP	CGHTUP	/YES
0074	1411		TAD	I 11	/NO. PUNCH STORED CHAR.
0075	6026		PLS		
0076				READP	/LOOP UNTIL END OF TAPE
22.0	3523		0.11	NEADI	AFF ON THE FAD OF THE
	4137	CGHTUP,			
0100	5025		JMP	READP	/READER ENABLED
	- '1				
0101	0000	ZNOR,	03	4	CUIDE TO BEAD I CARES
0102		2110113			/SUBR. TO READ LEADER
				READ	
0103				K177	/IGNORE BLANKS, 200'S
0104	7650		SNA	CLA	
0105	5102		JMP	3	
0106					FYIT WING PRANT OF CAME
2.20	3321		Olar	T ZIVON	/EXIT WITH FRAME IN SAVE
0100	0000				
0107		READ,	0		/READS LEADER; CHECKSUMS
0110			RSF		
0111	5110		JMP	1	
0112	7200	KCLA,	CLA	1	
	6016		RRB	DEC	
0114					
				SAVE	
	1024			SAVE	
0116	5507		JMP	I READ	
					· ·
0117	0000	ADCHK,	0		CHIPD TO DEAD TARE OF CHICAGO
0120			_	READ	/ SUBR. TO READ TAPE CKSUMS.
0121					/GET FRAME
	1176			HALT	
0122	7740		SMA	SZA CLA	
0123			JMP	3	/IGNORE RUBOUTS, CTRL/Z,
0124	4107		JMS	READ	/ AND FORM.
0125	4535			I GET2	
			0113	1 0212	/GET 2-FRAME CKSUM WORDS
0104					
0126	0000		Ø	_ ^. ,	/ARGUMENTS (4)
0127	0000	CKIB,	0		
0130	0000	CK2A,	Ø		
Ø131	0000	CK2B,	Ø		FYIT DIRECT CER HORSE
		32.57			/EXIT DIRECT (SEE "GETTWO")
0120	0122	V122	1.00		
0132	0177		177		
	0201	K201,	201		- 4,
0134	0077	K77,	77		
0135	0400	GET2.	GETT	WO	
		PCHECK,			
			J	••	



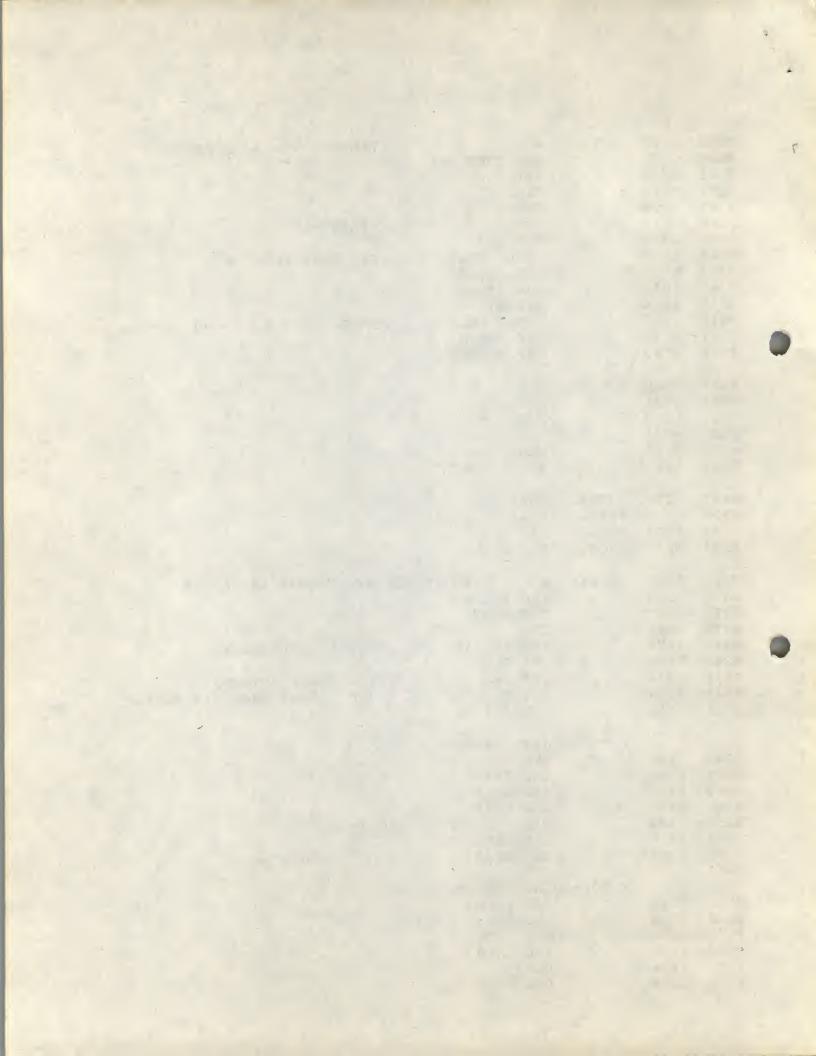
0137	0000	RESET.	Ø /RESET	BUFFER PTRS., READER SWITCH
0140	7300	100	CLA CLL	
	1023		TAD BOTM	/577+1=600
0142			DCA 10	
	1010		TAD 10	
	3026	7	DCA 11 DCA SW1	
0146			JMP I RESET	
2.40	3307		OMP I RESEL	
0147	0000	LDR,	Ø	/SUBR. TO PUNCH LEADER
0150	7041		CIA	and the second s
0151	3021		DCA CTR2	
	7604		LAS .	/READ BIT 4 OF S.R.
0153			AND KCLA	/RESULT: BLANK, OR 200
	4560		JMS I .+4	/TO "PUNCH"
	2021		ISZ CTR2	
Ø156 Ø157			JMP4	
0160	-		JMP I LDR	
0161		K15,	PUN CH	
6101	0015	NIS,	15	
		*176		
0176	7402	HALT,	HLT	/NORMAL HALT, NO ERRORS.
0177	7610		CLA SKP	RESTART BY "CONTINUE"
		/****	START AT 0200:	****
0200	6026		PLS	
0201	4137	RESTRT,		ADDREED DADE DEADE
0202	6014	RESIRIS	RFC	/BUFFER PTRS., READER
0203	1066		TAD KJMP2	
0204	3064		DCA PUN	/INHIBIT PUNCH
0205	3126		DCA CKIA	7 1.1.1.2.1.1.4.0.1.
0206	3127		DCA CKIB	
0207	3130		DCA CK2A	
0210			DCA CK2B	/ CLEAR 'EM
0211	7604		LAS	
	7710		SPA CLA	/BIT Ø SET?
	5237			/YES: "MASTER"
0214	7604		LAS	/NO, WAS BIT 1 SET?
Ø215 Ø216	7104		CLL RAL	
0217			SPA CLA JMP COPY	AVEC. HOO DWH
221	2232		OMP COPT	/YES: "COPY"
0220	1227	VERIFY,	TAD KEXITU	/NO, VERIFY A TAPE:
	3020		DCA EXIT	vonzi i n infe;
0222				/IGNORE LEADER (BLANK OR 200)
	4333			/1ST SIGNIF. CHAR.
0224	5025		JMP READP	/PUNCH IS STILL INHIBITED
2005				
	4117	EXITU,	JMS ADCHK	/COMPUTE CHECKSUMS & COMPARE
0226	5176	12-12	JMP HALT	/IF "ADCHK" FINDS NO ERROR



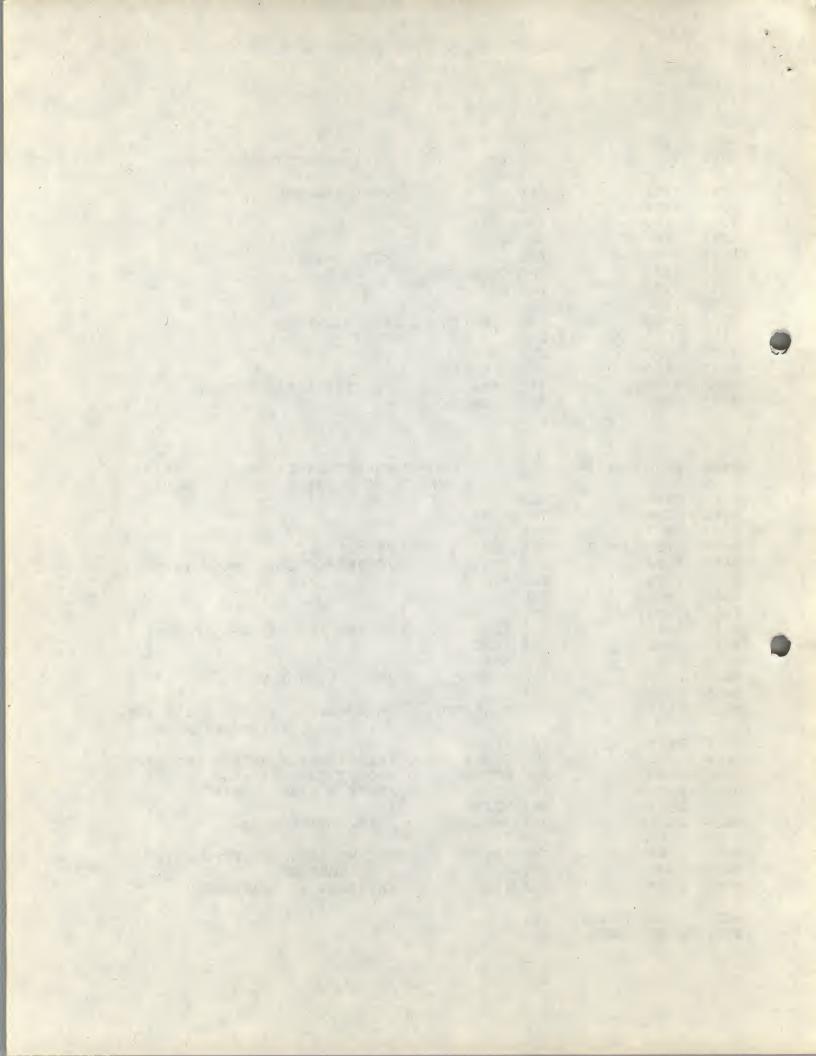
	0227	Ø225	KEXITV,	EXITU	
	0230		KEXITC,		
	0231		KEXITM,		
	0232	1230	COPY,	TAD KEXITC	/COPY A MASTER TAPE:
	Ø233	5240		JMP MASTER+1	THE LANGUE OF TH
				(	
	0234	4117	EXITC,	JMS ADCHK	
	0235	4271		JMS PUNREST	
ŧ	Ø236	5252	v	JMP PUNCHK+2	
					,
	0237		MASTER,	TAD KEXITM	/CREATE A MASTER TAPE:
	0240	3020		DCA EXIT	
	0241			DCA PUN	/ENABLE PUNCH
		1134		TAD K77	
		4147		JMS LDR	
		4101		JMS ZNOR	/EXIT W. NON-Ø CHAR. IN SAVE
		4333		JMS CHECK	
	0246	5025		JMP READP	
				1 6	
	0247			JMS PUNREST	
		1331	PUNCHK,	TAD RBT	/ PUNCH RBTS., HALTS, CKSUMS
	0251	4321		JMS PUNCH	/(MASTER GETS 3 RBTS., COPIES 2)
					* 1
	0252	1327	100	TAD CTRLZ	/12, END-OF-FILE FOR OS-8
		4321		JMS PUNCH	
	<b>@254</b>	1330		TAD FORM	/END-OF-FILE FOR SYMBOLIC ED.
				1	(ED. IGNORES +Z)
	Ø255	4321	_ *	JMS PUNCH	
		1126		TAD CKIA	/PUNCH 8 CKSUM. FRAMES:
		4303		JMS PUN2	/1 WD. = 2 FRAMES
		1127		TAD CKIB	
	0261	4303		JMS PUN2	
		1130		TAD CK2A	
	0263	4303		JMS PUN2	Sign of the second
	0264	1131	*	TAD CK2B	
	Ø265	4303		JMS PUN2	
		1161		TAD K15	
	0267	4147		JMS LDR	
	0270	5176		JMP HALT	
	70F1	2255		1	
	0271		PUN RES,	0	/ PUNCH REST OF TXT. BUFFER
	0272			CLA	
	0273	1010		TAD 10	V .
	0274	7041		CIA	
	0275	1011		TAD 11	
	0276	7650		SNA CLA	
	0277 0300	5671		JMP I PUNREST	/BUFFER EMPTY
	0300	1411		TAD I 11	
	0302	4321 5272		JMS PUNCH	/PUNCH CHAR.
1	2002	3212		JMP PUNRES+1	



```
0303
     0000
            PUN2,
                    0
                                    /PUNCH 1 WD. AS 2 FRAMES
 0304 3332
                    DCA STOR
 0305
     1332
                    TAD STOR
 0306
      7112
                    CLL RTR
0307
      7012
                    RTR
0310
     7012
                    RTR
                                  /FIRST HALF
0311
     0134
                    AND K77
0312
     1112
                    TAD KCLA
                                  /SET TAPE CHAN. 8
Ø313
     4321
                    JMS PUNCH
0314
     1332
                   TAD STOR
0315
      0134
                   AND K77
0316
     1112
                    TAD KCLA
                                  /SAME. (THIS TO FOOL RIM)
0317
     4321
                  JMS PUNCH
0320
      5703
                   JMP I PUN2
0321
      0000
           PUN CH,
                   0
0322 6021
                   PSF
0323 5322
                   JMP . - 1
0324 6026
                   PLS
0325 7200
                   CLA
0326 5721
                   JMP I PUNCH
Ø327
      0232
           CTRLZ
                   232
0330 0214 FORM,
                   214
0331
      Ø377
           RBT.
                   377
0332
      0000
           STOR
                   0
                   Ø /STORE CHAR., UPDATE CHECKSUMS
0333
      0000 CHECK,
0334
     7300
                   CLA CLL
0335 1020
                   TAD EXIT
0336
     7041
                   CIA
Ø337
     1227
                   TAD KEXITY
                                  /"VERIFY" PROGRAM?
0340 7650
                   SNA CLA
0341
     5344
                   JMP .+3
                                  /YES, STORE NOTHING!
0342 1024
                    TAD SAVE
                                    /NO, STORE CHAR. IN BUFFER
0343
     3410
                     DCA I 10
           / "STRAIGHT" CKSUM:
0344 7100
                   CLL
0345
    1024
                   TAD SAVE
    1127
0346
                   TAD CKIB
0347 3127
                   DCA CKIB
0350
     7004
                   RAL
                                  /GET CARRY
0351
    1126
                TAD CKIA
0352
     3126
                  DCA CKIA
           / "CIRCULAR" CKSUM:
Ø353
    1131
                   TAD CK2B
0354
     7104
                   CLL RAL
Ø355
     3131
                   DCA CK2B
0356
    1130
                   TAD CK2A
Ø357
     7004
                   RAL
0360
    3130
                   DCA CK2A
```



```
0361 7430
                  SZL
                ISZ CK2B
Ø362 2131
                                /WHICH CAN'T OVERFLOW
0363 7100
                  CLL
                                /NOW ADD NEW FRAME
0364 1024
                  TAD SAVE
0365 1131
                 TAD CK2B
0366 3131
                 DCA CK2B
0367 7004
                 RAL
                                /GET CARRY
0370 1130
                  TAD CK2A
0371 3130
                 DCA CK2A
0372 7420
                 SNL
0373 5733
                  JMP I CHECK /NO OVERFLOW
0374 2131
                 ISZ CK2B
0375 5733
                 JMP I CHECK
0376 2130
                ISZ CK2A
                               /IF THERE WAS A CARRY
0377 5733
                JMP I CHECK
         . / . . . . . . . .
0400 0000 GETTWO, 0 /READ 2 24-BIT CHECKSUMS (8 FRAMES);
/COMPARE WITH COMPUTED "CK" VALUES.
                 CLA
0401
     7200
0402 1230
                 TAD MIN4
0403 3021
                 DCA CTR2
0404 4107 LOOPG, JMS READ
                               /GET FRAME
0405 0134
                 AND K77
                               /DROP THE EDGE PUNCH (200)
0406 7106
                 CLL RTL
0407 7006
                 RTL
0410 7006
                 RTL
                              /FRAME IN BITS 0-5 OF TEMP
0411 3231
                 DCA TEMP
0412 4107
                 JMS READ
0413 0134
                 AND K77
0414 1231
                 TAD TEMP
                               /PACK INTO 1 WD.
0415 7041
                  CIA
0416 1600
                 TAD I GETTWO /ARGUMENTS: 4 SUCCESSIVE WDS.
                                / [ CK1A, CK1B, CK2A, CK2B ]
0417 7640
                SZA CLA
                 JMP ERROR
0420 5225
                                /DISCREPANCY BETWN. CKSUMS.
0421 2200
                 ISZ GETTWO
                                /POINT TO NEXT ARG.
                ISZ CTR2
0422 2021
                                /DONE 8 FRAMES YET?
0423 5204
             JMP LOOPG
                                /NO
                               /YES. NO ERRORS.
0424
     5517
                 JMP I ADCHK
     1200 ERROR, TAD GETTWO
0425
                                /SHOWS ADRS. OF CKSUM WHICH
          - 1-11
     7402
5177
0426
                 HLT
                                / DISAGREES.
                 JMP 177
0427
                                /RESTART BY "CONTINUE"
0430
     7774 MIN4, -4
0431 0000 TEMP.
```



ADCHK	0117
BOTM	0023
CGHTUP	0077
CHECK	Ø333
CKIA	0126
CKIB	0127
CK2A	0130
CKSB	0131
COPY	0232
CTRLZ	0327
CTR2	0021
DMY	0000
ERROR	0425
EXIT	0020
EXITC	0234
EXITM	0247
EXITU	Ø225
FORM	0330
GETTWO	0400
GET2	0135
HALT	0176
KCLA	0112
KEXITC	0230
KEXITM	0231
KEXITU	0227
KJMP1	0035
KJMP2	0066
K15	Ø161
K177	0132
K201	0133
K77	0134
AII .	
LDR	0147
LOOPG	0404
MASTER .	0237
MIN4	0430
PCHECK	0136
PUN.	0064
PUNCH	0321
PUNCHK	0250
PUNRES	Ø271
PUN2	0303
RBT	0331
RBTFLG	0022
READ	0107
READIT	0046
READP	0025
RESET	0137
RESTRT	0201
SAVE	0024
STOR	0332
SWI	0026
TEMP	0431
TIME	0036
VERIFY	
	6558
ZNOR	0101

